Polychlorinated Biphenyl Quantification Via Multiple Analytical Techniques

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Background/Objectives. Operable Unit 5 of the Allied Paper Inc./ Portage Creek/ Kalamazoo River Superfund Site (Site), located in southwest Michigan, includes approximately 80 miles of the Kalamazoo River and associated floodplains. Site sediments and floodplain soils are primarily contaminated with polychlorinated biphenyls (PCBs) from former paper mills that recycled and/or de-inked and repulped carbonless copy wastepaper. Remedy selection and implementation are driven by total PCB (TPCB) concentrations in soils and sediments based on the potential risk to terrestrial recreationalists and anglers who consume fish, thus accurate TPCB quantification is essential. Soil and sediment data at the Site has been collected from 1993 to present by multiple parties (i.e. United States EPA [EPA], Michigan Department of Environment, Great Lakes, and Energy [EGLE], Responsible Parties) and samples collected at the Site were historically analyzed using method 8082 (M8082) for select Aroclors and summing the detected Aroclors ($TPCB_{AROCLOR}$) to calculate TPCB. EGLE questioned if the existing site Aroclor analyses and $TPCB_{AROCLOR}$ concentrations are consistently representative of site conditions. Recent soil sampling in several different areas of the Site using M8082 showed unexpectedly lower $TPCB_{AROCLOR}$ concentrations (often by a factor of two or more) when compared to historical samples from the same area, without a plausible physical mechanism for the observed decline. Further, a limited number of split soil samples analyzed for PCB concentrations by both Aroclor and congener methods showed a low bias across the majority of soil $TPCB_{AROCLOR}$ results when compared to the congener concentrations for the same sample, regardless of the laboratory performing the Aroclor analysis. EPA subsequently led the development of a site-specific $TPCB_{AROCLOR}$ analytical standard operating procedure. However, it is still important to understand the differences that the various “standard” analytical laboratory techniques can yield in TPCB quantification for consideration at other sites.

Approach/Activities. To investigate the cause(s) of the PCB quantification issues, EGLE analyzed multiple Site samples from both subaqueous sediments and exposed floodplain soils. Samples were analyzed using three analytical methods: SW-846 M8082 to measure Aroclors, Method 680 (M680) to measure homologs, and Method 1668A (M1668A) to measure PCB congeners. Data from multiple laboratories, including the laboratory currently analyzing all Site sediment and soil samples for $TPCB_{AROCLOR,}$ were used in EGLE’s data analyses. EGLE’s quantitation of TPCB concentration was accomplished by summing the detected Aroclors, homologs ($TPCB_{HOMOLOG}$), or congeners ($TPCB_{CONGENER}$). All samples were analyzed for Aroclors using M8082. A subset of samples spanning the range of low- to high-level detections of $TPCB_{AROCLOR}$ concentrations will then be analyzed for TPCB by homologs using method 680 and TPCB by congeners using M1668A.

Results/Lesson Learned. Statistical comparisons of $TPCB_{AROCLOR}$, $TPCB_{CONGENER}$, and $TPCB_{HOMOLOG}$ concentrations from the same parent sample will be used to determine if the “standard” Aroclor analyses and $TPCB_{AROCLOR}$ concentrations are representative of TPCB concentrations and, if not, attempt to determine if M680 is a cost-effective and representative alternative analytical method for quantifying TPCB concentrations in Site sediments and soils.